August 1971

Brief 71-10282

NASA TECH BRIEF

NASA Pasadena Office

Environmental Effects on Silicon Solar Cells

A series of environmental tests was performed on batches of silicon solar cells having titanium-silver contacts, with and without solder coating, to determine the effects of these environments on the mechanical and electrical properties of the cells. The tests were initiated because of a major problem encountered by users of silicon solar cells, i.e., the loss of contact pull strength after exposure to various environments. This loss can be so severe in vacuum metallized silver over titanium (Ag-Ti) contacts that it is necessary to put a protective layer of lead-tin-silver solder (36 Pb, 62 Sn, 2 Ag) over the contact strips. While this solder coating protects the Ag-Ti contacts from environmental attack, it creates other problems, such as adding the weight of the solder, producing a thermal shock in the cell during solder dipping, and increasing the possibility of cell cracking or delamination during thermal cycling, due to excessively heavy or uneven solder coating.

The cells analyzed in the experimental program represented two main types: N on P, 0.04 cm thick cells with solder-coated Ag-Ti contacts; and N on P, 0.02 cm thick cells with nonsolder-coated Ag-Ti contacts.

Cells with solder coating exhibited the largest electrical and mechanical degradations after exposure to a series of five thermal cycles from 408 to 77 K. Cells without solder coating exhibited the largest mechanical degradation after a 36 hour exposure at 418 K. The latter, however, did not result in significant electrical degradation. Thus, the presence of solder coating on solar cells can have a protective or deleterious effect, depending on the environment.

It was observed that either solder-coated or nonsolder-coated cells were capable of surviving all the environmental tests with essentially no degradation indicating that problems were in the process controls rather than in the basic cell process. Analysis indicated that, in the case of solder-coated cells, the major problem was in the control of solder thickness and uniformity. In the case of nonsolder-coated cells, the major problem area was not identified; however, it was postulated that more than one mechanism was operating since it was not possible to correlate electrical degradation with contact pull-strength degradation.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA-TR-321362 (N69-18012), Effects of Environmental Exposures on Silicon Solar Cells

Patent status:

No patent action is contemplated by NASA.

Source: R. Moss and P. Berman of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11475)

Category 02